DP 300566
(DEP-0048)

REMARKS

Claims 1-35 are pending in the present application. Claims 1, 2, 6, 9, 16, 20, 21, and 27 have been amended, Claims 33-35 have been canceled, and Claims 36 and 37 have been added, leaving Claims 1-32, 36, and 37 for consideration upon entry of the present Amendment. Claim 1 has been amended in part to provide proper antecedent support for the dried mixture. Support for this amendment is found in Claim 1 as originally filed. Claims 1 and 16 have been amended to clarify that the balance of the zirconia is in the cubic and tetragonal phases. Support for this amendment is found at Page 5, lines 18-21 of the Specification. The remaining amendments made to the Claims, and the support for each of these amendments is detailed below. Claims 36 and 37 have been added to further claim the invention rather than to overcome any rejections related to patentability. Support for newly added Claims 36 and 37 is found at Page 5, line 25 – Page 6, line 5 of the Specification as originally filed. The Specification has been amended to correct certain typographical errors. No new matter has been introduced by these amendments. Reconsideration and allowance of the claims is respectfully requested in view of the above amendments and the following remarks.

Election/Restrictions

The Examiner has responded to Applicants' election with traverse submitted in Paper No. 4 by stating that the restriction requirement between Group I (Claims 1-32), Group II (Claim 33), and Group III (Claims 34 and 35) is indeed proper. The Examiner has, therefore, made the election requirement final. Consequently, Applicants have canceled Claims 33-35, without prejudice, as being drawn to a non-elected Group.

Claim Rejections Under 35 U.S.C. §112, Second Paragraph

Claims 1-32 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. In particular, Claims 1 and 16 are rejected as allegedly not specifying what specifically is being co-fired. Applicants have amended Claims 1 and 16 to clarify what is being co-fired. Support for this amendment is found, e.g., at Page 7, lines

8-24 of the Specification as originally filed.

Claims 2, 6, 20, and 21 are rejected as it is allegedly unclear as to what the percentage of monoclinic zirconia is based on. Claims 2, 6, 20, and 21 have been amended to clarify that the claimed weight percent is based upon the total weight of the zirconia. Support for these amendments is found at Page 5, lines 18-21 of the Specification, and in Claims 1 and 16 as originally filed.

Claims 9 and 27 stand rejected as there is no antecedent basis for the term "said laminated mixture" as no previous lamination has been set forth. Claims 9 and 27 have been amended to remove the term "laminated" from the claims. Support for this amendment is found in Claims 1 and 16 as originally filed.

Claim 16 stands rejected as there is allegedly no antecedent basis for "said alumina body." Claim 16 has been amended to convert "an unfired alumina surface" to "an unfired alumina body" such that the language is congruous with the remainder of the claim. Support for this amendment is found in Claim 16 as originally filed.

Claim Rejections Under 35 U.S.C. §103(a)

Claims 1, 4, 6-16, 18, 20-22, and 25-32 stand rejected under 35 U.S.C. §103(a), as allegedly unpatentable over U.S. Patent No. 6,258,233 to Sugiyama et al. ("Sugiyama") in view of U.S. Patent No. 4,221,650 to Friese et al. ("Friese") with evidence provided by the Practical Handbook of Material Science.

In particular, with regard to Claim 1, the Examiner states that Sugiyama discloses a method of manufacturing a zirconia-alumina body that comprises mixing zirconia, yttria, and at least one solvent to form a mixture (Column 6, lines 48-56). The mixture is dried (Column 7, line 60) and disposed adjacent to an unfired alumina body and the zirconia and the alumina bodies are co-fired together (Column 8, lines 11-19 and lines 34-38). The zirconia utilized by Sugiyama allegedly comprises a percentage of monoclinic phase, as measured from the diffraction intensities, that varies between 5 and 25% based on the total weight of the zirconia (Column 2, lines 38-50). The Examiner concedes that Sugiyama does not suggest also

including alumina to the zirconia mixture. However, the Examiner states that Friese teaches, in an alternate method for preparing zirconia for electrochemical sensors, that adding alumina to the zirconia mixture improves the heat conductivity of a constructed sensor while also reducing its coefficient of expansion (Column 3, lines 2-6). The Examiner states, therefore, that it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Friese for the method of Sugiyama in order to improve the constructed sensors heat conductivity and reduce its coefficient of expansion. With regard to the rejection of Claims 4, 6-16, 18, 20-22, and 25-32, the Examiner has provided specific citations to Sugiyama, Friese, and the Practical Handbook of Materials Science. Applicants respectfully traverse this rejection.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing a prima facie case of obviousness. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). Establishing a prima facie case of obviousness requires that all elements of the invention be disclosed in the prior art. *In re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A 1970).

Independent Claim 1 sets out in part: "....wherein said zirconia-alumina body comprises about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia." Independent Claim 16 sets out in part: "....co-firing said unfired zirconia-alumina body to form a co-fired zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia." Therefore, in order to establish a prima facie case of obviousness, Sugiyama in combination with Friese must at least teach a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia.

Sugiyama teaches a zirconic solid electrolytic body made of a partially stabilized zirconia having a mixed phase structure including a cubic phase, a monoclinic phase, and a tetragonal phase (Abstract). The monoclinic/cubic ratio of the partially stabilized zirconia is in a range from 0.05 to 0.25 (Abstract; Col. 2, lines 29 - 31). Therefore, Sugiyama teaches a percentage of the monoclinic phase in relation to only the cubic phase of the zirconia.

At room temperature there is no T. phase

Sugiyama fails to teach the weight percent of the monoclinic zirconia in relation to the total amount of zirconia.

In contrast to Sugiyama, Applicants teach and claim a weight percent of monoclinic phase zirconia based on the total amount of zirconia. In other words, the amount is based upon the total of the monoclinic, cubic, and tetragonal phases. Sugiyama, in contrast, discloses a monoclinic/cubic phase ratio based on reflective integrated intensities, wherein the ratio does not consider the amount of the tetragonal phase contained in the zirconia. Therefore, Sugiyama discloses a percentage amount of monoclinic phase zirconia based on only a portion of the zirconia present, i.e., monoclinic and cubic phases with no consideration as to the amount of tetragonal phase present. Basically, Sugiyama is concerned about the amount of monoclinic phase present in relation to the amount of cubic phase present. Sugiyama fails to discuss the relation of the monoclinic phase to the total amount of zirconia. Therefore, because the amount of the monoclinic phase disclosed in Sugiyama and that claimed by Applicants are unrelated amounts, i.e., the ratio of monoclinic:cubic phase versus a percentage based on the total amount of zirconium phases present. Since Sugiyama fails to teach about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia, and fails to teach the mixing of alumina with the zirconia and yttia, Sugiyama fails to teach or suggest all elements of Applicants' claimed invention.

Friese teaches an Al_2O_3-containing stabilized cubic zirconium dioxide containing between about 8% and 85% by volume Al_2O_3 (Abstract; Column 3, lines 13-25). Friese fails, however, to even teach that the zirconia employed does or can comprise any other phases besides cubic. Friese specifically teaches and claims using cubic zirconia. There is no teaching regarding monoclinic and tetragonal zirconia, and no teaching regarding the amounts of the monoclinic zirconia.

Since both Sugiyama and Friese fail to teach or suggest a method of manufacturing a zirconia-alumina body comprising comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia, since Sugiyama and Friese are directed to different types of zirconia (Sugiyama teaches a specific monoclinic/cubic ratio, while Friese teaches only cubic; in other

words, different materials with no motivation to combine), either alone or in combination, these references fail to teach all elements of Applicants' claimed invention. Therefore, a prima facie case of obviousness has not been established for these claims. Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection.

Further, with respect to the Practical Handbook of Materials Science, this is merely an explanation of the properties of alumina and zirconia. It does not remedy the deficiencies of Friese and Sugiyama. It fails to teach any combinations of materials at all, and also fails to teach amounts of the zirconia phases. Consequently, even in view of the Practical Handbook of Materials Science, Sugiyama and Friese, alone and in combination, fail to render the present claims obvious.

Claims 2, 3, and 24 stand rejected under 35 U.S.C. §103(a), as allegedly unpatentable over Sugiyama in view of Friese as applied to Claims 1 and 22, and further in view of U.S. Patent No. 5,968,673 to Aizawa et al. ("Aizawa"). In particular, the Examiner states that Aizawa teaches that, in an alternate solid electrolyte construction, adding a dispersant to a ceramic mixture improves the dispersion of the particles in the slurry allowing for a more homogeneous mixture (Column 4, lines 20-27). The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of a dispersant in order to create a homogeneous mixture of the electrolyte particles. With respect to the concentration of monoclinic zirconia in the zirconia-alumina, the Examiner states that Sugiyama particularly teaches the use of compositions between 18 and 25% monoclinic (Figure 13; Tables 1-3). Applicants respectfully traverse this rejection.

Claims 2 and 3 are dependent on Claim 1, and Claim 24 is dependent on Claim 22, which depends from Claim 16. As stated previously, both Claims 1 and 16 set out in part a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia. As a prima facie case of obviousness requires that all elements of the claim be taught or suggested by the prior art, Sugiyama, Friese, and Aizawa, either alone or in combination, must teach or suggest a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

As previously stated, neither Sugiyama, nor Friese, either alone or in combination, teach a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia. The figure referred to by the Examiner fails to teach the amount of monoclinic phase in the zirconia, it merely shows the ratio of the monoclinic to the amount of monoclinic and cubic, not the amount of monoclinic based upon the total weight of the zirconia. Applicants further submit that Aizawa, at a minimum, also does not teach this claim limitation. Rather, Aizawa teaches a solid electrolyte thin film comprising yttrium stabilized zirconia (Abstract). Unlike Applicants' claimed invention, Aizawa makes no reference to the amount of monoclinic zirconia in the film; actually, Aizawa fails to mention zirconia phases at all. Therefore, Aizawa does not compensate for the deficiencies of Sugiyama and Friese. Therefore, because these references, either alone or in combination, do not teach the claimed amount of monoclinic zirconia, a prima facie case of obviousness has not been established. Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection.

Claims 5 and 23 stand rejected under 35 U.S.C. §103(a), as allegedly unpatentable over Sugiyama in view of Friese as applied to Claims 1 and 22, and further in view of U.S. Patent No. 4,897,174 to Wang ("Wang"). In particular, the Examiner states that Wang teaches that, in an alternate electrochemical sensor construction, exposing a ceramic mixture to a vacuum ensures that the slurry possesses no trapped air (Column 3, lines 32-34). The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Wang for the method of Sugiyama and Friese in order to ensure that there is no trapped air in the mixture. Applicants respectfully traverse this rejection.

Claim 5 is dependent on Claim 4, which is dependent on Claim 1. Claim 23 is dependent on Claim 22, which is dependent on Claim 16. As stated previously, both Claims 1 and 16 set out in part a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia. As a prima facie case of obviousness requires that all elements of the claim be taught or suggested by the prior art, Sugiyama, Friese, and Wang,

either alone or in combination, must teach or suggest a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

As previously stated, neither Sugiyama, nor Friese, either alone or in combination, teach a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia. Applicants further submit that Wang, at a minimum, also does not teach this claim limitation. Rather, Wang teaches a gas sensor element of yttria-stabilized zirconia (Abstract). Unlike Applicants' claimed invention, Wang makes no reference to the amount of monoclinic zirconia in the film; actually, Wang does not mention the phases of zirconia at all. Therefore, Wang does not compensate for the deficiencies of Sugiyama and Friese. Therefore, because these references, either alone or in combination, do not teach the claimed amount of monoclinic zirconia, a prima facie case of obviousness has not been established. Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection.

Claim 17 stands rejected under 35 U.S.C. §103(a), as allegedly unpatentable over Sugiyama in view of Friese as applied to Claim 16, and further in view of U.S. Patent No. 5,849,165 to Kojima et al. ("Kojima"). In particular, the Examiner states that Kojima teaches that, in an alternate sensor, the application of a protective layer over the measuring electrode protects said electrode from Si-poisoning (Column 2, lines 3-27). The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Kojima for the method of Sugiyama in view of Friese in order to protect the sensor from silicon poisoning. Applicants respectfully traverse this rejection.

Claim 17 depends from Claim 16. As stated previously, Claim 16 sets out in part a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia. As a prima facie case of obviousness requires that all elements of the claim be taught or suggested by the prior art, Sugiyama, Friese, and Kojima, either alone or in combination, must teach or suggest a zirconia-alumina body comprising about 1 weight% to

about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

As previously stated, neither Sugiyama, nor Friese, either alone or in combination, teach a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia. Applicants further submit that Kojima, at a minimum, also does not teach this claim limitation. Rather, Kojima teaches an oxygen sensor element (ZrO_2 solid electrolyte etc.) for detecting the oxygen concentration in an exhaust gas (Abstract). Unlike Applicants' claimed invention, Kojima makes no reference to the amount of monoclinic zirconia in the film or the mixture of the alumina with the zirconia. Kojima fails to even mention the zirconia phases. Therefore, Kojima does not compensate for the deficiencies of Sugiyama and Friese. Therefore, because these references, either alone or in combination, do not teach the claimed amount of monoclinic zirconia, a prima facie case of obviousness has not been established. Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection.

Claim 19 stands rejected under 35 U.S.C. §103(a), as allegedly unpatentable over Sugiyama in view of Friese as applied to Claim 18, and further in view of U.S. Patent No. 6,346,178 to Lankheet ("Lankheet"). In particular, the Examiner states that Lankheet teaches that, in an alternate electrochemical sensor, the inclusion of a ground plane 42 can prevent the premature failure of the heater (Column 4, lines 52-64). The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was being made to utilize the teaching of Lankheet for the method of Sugiyama and Friese in order to prevent the premature failure of the heater. Applicants respectfully traverse this rejection.

Claim 19 depends from Claim 18, which depends from Claim 16. As stated previously, Claim 16 sets out in part a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia with the balance cubic and tetragonal phases, based upon the total weight of the zirconia. As a prima facie case of obviousness requires that all elements of the claim be taught or suggested by the prior art, Sugiyama, Friese, and Lankheet, either alone or in combination, must teach or suggest a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

As previously stated, neither Sugiyama, nor Friese, either alone or in combination, teach a zirconia-alumina body comprising about 1 weight% to about 45 weight% monoclinic phase zirconia. Applicants further submit that Lankheet, at a minimum, also does not teach this claim limitation. Rather, Lankheet teaches a device for sensing gas concentration in an exhaust flow comprising a dielectric substrate, a heater disposed within said substrate, a ground plane disposed within the substrate, and a cell consisting essentially of: an outer electrode disposed in electrical communication with an electrolyte, an inner electrode disposed in electrical communication with the electrolyte opposite to the outer electrode, and a protective layer disposed in fluid communication with the outer electrode, wherein the inner electrode is sealed such that gas contacting the inner electrode must first diffuse through the protective layer, the outer electrode, and the electrolyte (Column 2, lines 23-34). Lankheet makes no reference to the amount of monoclinic zirconia in the film. Therefore, Lankheet does not compensate for the deficiencies of Sugiyama and Friese. Therefore, because these references, either alone or in combination, do not teach the claimed amount of monoclinic zirconia, a prima facie case of obviousness has not been established. Accordingly, Applicants respectfully request reconsideration and withdrawal of this rejection.

Applicants furhter contend that there is insufficient support to combine the references as suggested. However, since the combinations clearly fail to teach the present claims, these points will not be discussed in detail at this time.

In light of the foregoing amendments and remarks, reconsideration and withdrawal of the rejections and allowance of the case is respectfully requested. It is believed that the foregoing amendments and remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants.

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DP 300566
(DEP-0048)

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 50-0831 maintained by Applicants' Assignee.

Respectfully submitted,

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DP 300566
(DEP-0048)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

A marked-up version of the 2nd full paragraph on page 6 follows:

Referring to Figure 5, line 50 represents alumina body contraction on cooling, line 52 shows a cubic/tetragonal zirconia body on cooling, and line 54 shows the cooling curve of a zirconia body comprising about 22 weight% monoclinic phase.. Note how, around 500°C, line 54 suddenly rises, showing the volumetric expansion of the tetragonal to monoclinic transformation. The mismatch of line 52 (which is a formulation like Sample 1 below) becomes worse relative to the alumina, line 50, as cooling continues.

A marked-up version of the 3rd full paragraph on page 6 continuing onto page 7 follows:

The process for producing a conductive co-fired body includes forming a batch mixture of zirconia, yttria, and alumina, along with solvent(s) such as xylenes, ethanol, and the like, and/or dispersant(s) such as phosphate ester, Menhaden fish oil, sulfosuccinate, castor oil, and the like. -This mixture is milled for a sufficient period of time to obtain a substantially homogeneous mixture, e.g., typically about 4 to about 12 hours. Thereafter, binder(s) (such as polyvinyl butyral, poly methyl methacrylate, poly vinyl formol, and the like), and plasticizer(s) (such as butyl benzyl phthalate, glycols (e.g., polyethylene glycol, and the like) and phthalates, (e.g., dimethyl phthalate, octyl phthalate, and the like) and others), can optionally be added to the mixture. The mixture is preferably mixed, e.g., milled, for an additional period of time to obtain a substantially homogeneous mixture, e.g., typically up to about 8 hours or so, to produce a slurry. The slurry produced is then preferably de-aired, which is typically achieved by pulling a vacuum on the slurry for up to about 3 minutes or so.

DP 300566
(DEP-0048)

A marked-up version of Claims 1, 2, 6, 9, 16, 20, 21, and 27 follows:

Claim 1. (Amended/marked-up) A method of manufacturing zirconia-alumina body, comprising:

mixing zirconia, yttria, and alumina with at least one solvent to form a mixture;

drying said mixture to form a dried mixture;

disposing said dried mixture adjacent to an unfired alumina body; and

co-firing said dried mixture and said unfired alumina body to form ~~the~~ a zirconia-alumina body, wherein said zirconia-alumina body comprises about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 2. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 1, further comprising mixing at least one dispersant into the mixture, and wherein the zirconia-alumina body comprises about 15 weight% to about 30 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 6. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 1, wherein the zirconia-alumina body comprises about 18 weight% to about 25 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 9. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 1, wherein said ~~laminated~~ mixture and said alumina body~~surface~~ have a sintering mismatch of less than about 5%.

DP 300566
(DEP-0048)

Claim 16. (Amended/marked-up) A method of manufacturing a sensor, comprising:

mixing zirconia, yttria, and alumina with at least one solvent to form a mixture;

drying said mixture to form an unfired zirconia body;

disposing an electrode on each side of said unfired zirconia body;

connecting each electrode to an electrical lead;

disposing said unfired zirconia body adjacent to an unfired alumina body~~surface~~ to form an unfired zirconia-alumina body, wherein one of said electrodes is disposed between said zirconia body and said alumina body; and

co-firing said unfired zirconia-alumina body to form a ~~the sensor, wherein the~~ co-fired zirconia-alumina body comprisinges~~es~~ about 1 weight% to about 45 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 20. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 16, wherein the zirconia-alumina body comprises about 15 weight% to about 30 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 21. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 16, wherein the zirconia-alumina body comprises about 18 weight% to about 25 weight% monoclinic phase zirconia, based upon the total weight of the zirconia.

Claim 27. (Amended/marked-up) The method of manufacturing zirconia-alumina body of Claim 16, wherein said ~~laminated~~ mixture and said alumina body~~surface~~ have a sintering mismatch of less than about 5%.